

REMARKS/ARGUMENTS

Claims 44-107 are pending in this application. The elected Group III claims, namely nos. 46, 52, 53, 59, 65, 70 and 90 are rejected, whereas non-elected claims 44, 45, 47-51, 54-58, 60-64, 66-69, 71-89 and 91-107 are withdrawn from consideration by the Examiner. Entry of this Amendment into the file of the present application is respectfully requested in that the response is believed to overcome all of the grounds for rejection. Reconsideration of all of the claim rejections is respectfully requested based on the remarks below.

Amendments to the Specification

The specification has been amended at pp. 27-28 to correct the values given therein for Aranesp, a doubly PEGylated EPO. The amendments made are the same amendments that were made to the specification of the corresponding International application during its prosecution. A translated copy of the International Preliminary Examination Report (IPER), issued by the International Preliminary Examining Authority (IPEA) at the European Patent Office concerning such International application was submitted to the USPTO with this application at the time of filing. Another copy is provided herewith for the convenience of the Examiner. The IPER report contains several annexes, including, *inter alia*, pages 27-28 of the application as amended during such prior International prosecution. The amendments were made, as indicated above, to correct a few typographical errors contained in the specification relating to the dose of the Aranesp. The amended pages were accepted by the IPEA and the corresponding entry of these amendments (to page 27) into the file of the present application is, therefore, respectfully requested.

Claim Rejections Under 35 U.S.C. §103

The Examiner continues to maintain the rejection of claims 46, 52, 53, 59, 65, 70 and 90 under 35 U.S.C. §103 over the combination of four references, namely Fatouros, M.S., et al., *Eur. J. Surg.* (1999), Krussel, J.S., et al., *Mol. Hum. Reprod.* (2001), EP 0613683 (Amgen) and U.S. Patent No. 6,274,158 (Zaharia Czeizler). This ground of rejection is respectfully traversed based on the ground(s) set forth below.

The above-identified references were extensively discussed in applicants' previous response filed in this case, dated November 26, 2007 and those remarks are specifically incorporated by reference herein. A brief, non-limiting summary of applicants' previous arguments is provided

below, however, in order to place certain additional arguments presented herein in their proper context.

Applicants in their prior response pointed out to the Examiner the significant difference(s) between the presently claimed dosage range versus those recited by the cited references. That is, the present claims recite a dosage range of 1 to 90 IU EPO/kg body weight per week. In contrast, the references cited to reject applicants' claims teach the use of much higher dosages of EPO, i.e., so much higher than the claimed dosage that applicants submit that the teaching of the prior art actually teaches away from the dosages recited for use in the claimed method. Further to the above, at least several of the cited references fail to teach or even suggest the claimed route of administration of the EPO and/or the use of EPO for the treatment of wounds, i.e., in accordance with the method as claimed by applicants.

Notwithstanding applicants' above-described arguments, however, the Examiner has continued to hold that the claimed EPO dosage levels represent nothing more than the 'optimum or workable ranges' which may be discovered by, e.g. routine experimentation. Applicants respectfully disagree, however, with the position taken by the Examiner for the reasons presented herein.

Applicants submit that the present claims represent an entirely different situation than the 'standard' cases relating to the optimization of numerical values. That is, the prior art teaches values of EPO that are not simply different in amount from those used in the presently claimed method, i.e., they also differ in the effect caused by the administration of the EPO. Taking the teaching of the Fatouros reference as an example, the reference discloses to administer 500 IU/kg/day for 22 days, which amounts to $22 \times 500 = 11,000 \text{ IU/kg/22 days}$ or approximately 3,500 IU/kg/week (see, e.g. p. 987, left column, under the heading "Treatment"). In contrast, as previously pointed out the presently claimed method utilizes a weekly dosage of 1 to 90 IU EPO/kg of body weight. Even taking into account the highest value claimed by applicants, i.e., 90 IU, this differs from the value taught by the reference by a factor of about 40x.

Fatouros, moreover, is not the only reference which teaches to use a significantly higher dosage (i.e., than that presently claimed) of EPO, but in fact almost all of the known prior art in this field teaches to use such (relatively) huge dosages. EP 0613683, for example, teaches (see p. 5, lines 9-10) to use 500, 1500 and even 4500 IU/kg of EPO. Applicants, thus construe that the combined teaching of the references in this field of art is directed toward the use of dosages which are significantly larger than those recited in applicants' claims.

Furthermore, as alluded to above the differences between the range of dosages taught for use in the prior art versus those recited in the present claims have a marked impact on the effect of the EPO so administered. This, then produces a difference not only in amount, but also in kind, as explained below.

As would be well known to one having an ordinary level of skill in this art, the administration of high dosage levels of EPO, i.e, of the sort taught in the prior art, results in significantly different effects to the subject to whom the composition is administered than the different 'class' of lower dose as taught for use by applicants. For Example, in reviewing the teaching of EP 0613683 relied upon (in combination with the other cited references to reject the present claims), it is evident from, e.g., Fig. 4 of the subject reference that at least one aim of the method described therein is to have a significant effect on the red blood cell count - that is, administration of dosages of the level taught by EP 0613683 and the other cited art significantly increases the hematocrit value of a subject's blood. This significant increase, therefore, correspondingly has an important effect on the subject's blood pressure, as well as producing a number of additional physical manifestations which are well known in this field of art.

In contrast, as taught for example, at p. 27 of applicants' specification, the dosages used in the claimed method are subpolycythemic doses - that is, doses which do not lead to erythrocytosis with hematocrit values of more than 50%. It is for this reason, therefore, as is also taught at the top of specification p. 27, that the dosages used in applicants' claimed method are 'very small amounts' which are significantly below the dosages taught for use in the prior art.

Further in support of the arguments above, applicants respectfully direct the Examiner's attention to the recent decision of the United States Supreme Court in *KSR Intern. Co. v. Teleflex Inc.*, 127 S. Ct. 1727 (2007) wherein the Court stated, for example, at p. 1740 that, "... [a] court must ask whether the improvement is more than the predictable use of prior art elements according to their established functions." Clearly, in the present case, if one of ordinary skill chooses to adhere to the teachings contained in the prior art for their 'predictable' effect, they would be led towards the use of elevated dosages of EPO and away from the use of subpolycythemic doses such as are presently recited in applicants' pending claims. Along these lines, M.P.E.P. §2143.01 holds that the mere fact that references can be combined or modified does not render the resultant combination obvious, unless the results would have been predictable to one of ordinary skill in the art. Applicants respectfully submit, however, that the effects of the presently claimed 'low' dosage

ranges for EPO would certainly not have been predictable to a skilled artisan in this field considering the combined disclosures of the references presently cited to reject the pending claims of this case which teach, in contrast to the claimed method, to use significantly higher dosages of the active substance. The KSR, *supra* decision goes on to state (see p. 1741) that, “There must be some articulated reasoning with some rational underpinning to support the legal conclusion of obvious.” In the present case, the Examiner’s ‘articulated reasoning’ is his apparent belief that the teaching(s) regarding, *inter alia*, the dosage of EPO to be administered contained in the cited references would suggest to one having ordinary skill in this art to modify the relatively high doses taught in these references and to utilize, instead, a dosage which in at least one instance is approximately 40 times lower than that which is taught for use by the reference(s). Applicants respectfully traverse this conclusion, arguing instead that references such as those cited which teach the use of elevated dosage levels certainly would not suggest to one in this art to materially reduce the dosage levels so taught. The present situation thus appears to applicants to represent just such a case as the Court warned about in *Graham v. John Deere Co.*, 383 U.S. 1, 36 (1966) which discusses the, “importance of guarding against hindsight . . . and resist[ing] the temptation to read into the prior art the teachings of the invention in issue” when considering the issue of obviousness. That is, the teaching to lower the dosage levels of the EPO is provided by applicants and no teaching to do so is discernible from the prior art references cited to reject applicants’ claims.

In summary therefore, one of ordinary skill in this art would readily recognize that the prior art, e.g, Fatouros, EP 0613683, etc. teaches to use dosage levels having direct effects on the red blood cell count of the subject to whom the EPO is administered. In contrast, however, applicants teaching is to avoid such large dosages, particularly because it is desired to avoid the effect on the subject’s blood which would otherwise be produced. This, then, represents a clear teaching away on the part of the prior art. That is, the art teaches one to introduce sufficient EPO to have a significant effect on the red blood cell level, whereas the claimed method is intentionally engineered to avoid just such an effect as is produced according to the prior art. This, then, clearly indicates that applicants’ claimed method is not at all obvious in light of the disclosure of the references combined to reject the claims under 35 U.S.C. §103.

Further demonstrating the non-obviousness of the method recited in applicants’ claims, A declaration from each of the co-inventors under 37 C.F.R. 1.132 is provided herewith, analyzing the effects erythropoietin has on the healing of skin wounds in mice. Provided as an attachment to both

declarations is a graph illustrating the experimental data obtained in accordance with this treatment. As indicated in the declarations, mice were treated by creating a 'standard' wound in their skin with a hole punch, after which various dosages of erythropoietin were administered and the effect on wound healing was determined.

According to the data thus obtained, a low-dose erythropoietin treatment, i.e., in accordance with the presently claimed method, led to the closing of the wounds after 7-8 days. A control group, treated only with physiological saline solution, showed wound closing after 13 days. Treatment of animals with high doses of erythropoietin (i.e., as in the prior art) did not show the accelerated wound healing obtained with the (low) doses of the invention, but instead, behaved similarly to the (control) group treated with the physiological saline solution.

These effects thus clearly demonstrate that the dosage represents a critical feature in determining the length of time needed to close the wounds on the skin of the treated animals. That is, dosages within the claimed ranges lead to particularly increased and accelerated wound healing when contrasted against significantly higher dosages, i.e., at the level(s) taught for use in the prior art.

Further to the above, it was found during these experimental trials that the treatment of the animals with high (i.e., at the level of the prior art) doses of EPO creates a negative result in that it leads to the formation of microthrombosis (i.e., small blood clots) at the wound edge(s). Furthermore, two of the animals treated with such high dosages actually died, i.e., most likely due to a stroke caused by exaggerated erythropoiesis and subsequent polycytemy.

The above data thus evidences the criticality of the claimed dose levels, in contrast to the results achieved with the higher doses taught in the prior art. The experimental results, therefore, provide still further evidence of the non-obviousness of applicants' claimed method.

For all of the reasons presented above, therefore, the Examiner is respectfully requested to reconsider and withdraw the rejection of applicants' claims under §103.

Double Patenting Rejection

Claims 46, 52, 53, 59, 65, 70 and 90 stand rejected on the ground of nonstatutory obviousness-type double patenting as being allegedly unpatentable over claims 4, 15-31 and 35-44 of co-pending Application Serial No. 10/586,896. The rejection is provisional due to the fact that

the conflicting claims have not, in fact, been patented. This ground of rejection is respectfully traversed.

As previously noted by applicants in their response dated November 26, 2007, the M.P.E.P. indicates (see §804 I B) that in the case of provisional obviousness-type double patenting rejections based on the claims of copending applications (as in the present instance):

The 'provisional' double patenting rejection should continue to be made by the Examiner in each application as long as there are conflicting claims in more than one application unless that 'provisional' double patenting rejection is the only rejection remaining in at least one of the applications. (Emphasis supplied by applicants).

Applicants respectfully submit that the arguments and evidence set forth above is believed to be clearly sufficient to overcome the §103 rejection of applicants' claims. Thus, the 'provisional' obviousness-type double patenting rejection should be "the only rejection remaining in" the present application. This factor, thus, should lead to the withdrawal of the double patenting rejection.

The Examiner is, therefore, respectfully requested to also reconsider and to withdraw the double patenting rejection of applicants' claims.

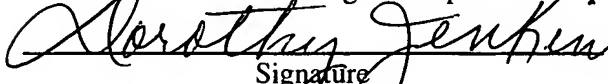
EXPRESS MAIL CERTIFICATE

Respectfully submitted,

I hereby certify that this correspondence is being deposited with the United States Postal Service as Express Mail to Addressee (mail label # EV 933191174 US) in an envelope addressed to: Mail Stop RCE, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on May 7 2008

Dorothy Jenkins

Name of Person Mailing Correspondence



Signature

May 7, 2008

Date of Signature

MAF:jl


Mark A. Farley

Registration No.: 33,170

OSTROLENK, FABER, GERB & SOFFEN, LLP

1180 Avenue of the Americas

New York, New York 10036-8403

Telephone: (212) 382-0700

PATENT COOPERATION TREATY



PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or Agent's file reference 25224 WO	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/EP 03/08229	International filing date (day/month/year) 07.25.2003	Priority date (day/month/year) 07.26.2002
International Patent Classification (IPC) or national classification and IPC A61K38/18		
Applicant BAHLMANN, Ferdinand Hermann et al.		

<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 10 sheets including this title page.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Instruction 607 of Administrative Instructions of the PCT).</p> <p>These annexes consist of a total of 8 sheets.</p>
<p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> I <input checked="" type="checkbox"/> Basis of the report II <input type="checkbox"/> Priority III <input checked="" type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability IV <input checked="" type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement according to Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input type="checkbox"/> Certain documents cited VII <input type="checkbox"/> Certain defects in the international application VIII <input type="checkbox"/> Certain observations on the international application

Date of submission of the demand 02.26.2004	Date of completion of this report 11.17.2004
Name and mailing address of the IPEA  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0, Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer: Winger, R Tel. +49 89 2399-8129 

I. Basis of the report

1. This report has been drawn up on the basis of the following elements *(the replacement sheets received by the receiving office in response to an invitation according to Article 14 are considered in the present report as "originally filed" and are not annexed to the report as they contain no amendments (Rules 70.16 and 70.17).):*

Description, pages:

1-27, 29-59 as originally filed

28 received on 10.18.2004 by fax

Claims, No.:

Insert no. here as originally filed

1-43 received on 10.18.2004 by fax

Drawings, sheets:

1/15-15/15 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

☐ the description, pages:

☐ the claims, Nos.:

☐ the drawings, sheets:

5. ☐ This report has been written disregarding (some of) the amendments, which were considered as going beyond the description of the invention, as filed, as is indicated below (Rule 70.2(c)):

(All replacement sheets comprising amendments of this nature should be indicated in point 1 and attached to this report).

6. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

- ☐ the entire international application,
☒ claims Nos. 24-32,38-43 (Industrial Applicability)

because:

- ☒ the said international application, or the said claims Nos. 24-32,28-43 (Industrial Applicability) relate to the following subject matter which does not require an international preliminary examination (*specify*):

see separate sheet

- ☐ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. are so unclear that no meaningful opinion could be formed (*specify*):
- ☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.
- ☐ no international search report has been established for said claims Nos.
2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:
- ☐ the written form has not been furnished or does not comply with the standard.
- ☐ the computer readable form has not been furnished or does not comply with the standard.

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

- ☐ restricted the claims.
☐ paid additional fees.
☐ paid additional fees under protest.
☐ neither restricted nor paid additional fees.

2. ☒ This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict the claims or pay additional fees.
3. This Authority found that, according to Rules 13.1, 13.2 and 13.3:
- ☐ the requirement of unity of invention is complied with.
- ☐ the requirement of unity of invention is not complied with, for the following reasons:
4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:
- ☒ all parts.
- ☐ the parts relating to claims Nos. .

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement
- | | | | |
|-------------------------------|------|--------|---------------|
| Novelty (N) | Yes: | Claims | 1-23,29-32,43 |
| | No: | Claims | 24-28,33-42 |
| Inventive Step (IS) | Yes: | Claims | 1-3 |
| | No: | Claims | 4-23,29-32,43 |
| Industrial Applicability (IA) | Yes: | Claims | 1-23,33-37 |
| | No: | Claims | |
2. Citations and explanations
- see separate sheet**

Re Item III

1. Claims 24-32 and 38-43 relate to a subject-matter which, in the opinion of this authority, falls under Rule 67.1 (iv) PCT. No opinion is therefore given on the industrial applicability of the subject-matter of these claims (Article 34(4) a) (i) PCT).

Re Item IV

2. This authority has found that the international application comprises a plurality of inventions or groups of inventions which are not linked so as to form a single general inventive concept (Rule 13.1 PCT), namely:

1. Claims 1-14, 24-28, 29-32 (in part), 33-43: Use of EPO in a dose of from 500 to 2 000 units/week/patient to stimulate endothelial progenitor cells, for the therapy of diseases and corresponding pharmaceutical compositions.
2. Claims 15-23, 29-32 (in part): Use of EPO for producing transplantable endothelial cell preparations, for producing cell-containing organ or tissue systems and for producing heart valves.

The reasons for this are as follows: based on the claims and the description, the problem underlying the present invention is to provide compositions and methods for improved stimulation of endothelial progenitor cells and for the therapy of disorders associated therewith, and endothelial cell preparations. The proposed solution is the administration of EPO on the one hand in general and on the other hand in a dose of from 500 to 2 000 units of EPO/week/patient. Unity is therefore lacking a priori. Apart from this, the documents WO 98 10650 A, US 5 980 887 A, BUEMI M et al. (J. Nephrol.) and KRAUSE K et al. (European Heart Journal) describe mitogenic and migratory effects of EPO on endothelial cells and its angiogenic effect. Since the use of EPO to stimulate endothelial cells including the formation of new blood vessels is known, inventions 1 and 2 are not linked by a common inventive concept. The requirement of unity of the invention (Rule 13.1 PCT) is thus not fulfilled since there is no technical relationship between the subject-matters of the groups of inventions involving one or more of the same or corresponding special technical features as required by

Rule 13.2 PCT.

Re Item V

3. Reference is made to the following documents of the international search report and the passages cited therein:
- D1: WO 03/057242 A
 - D2: WO 02/14356 A
 - D3: US 2002/065214 A1
 - D4: WO 00/61164 A
 - D5: WO 98/10650 A
 - D6: US-A-5 980 887
 - D7: NEPHROLOGY DIALYSIS TRANSPLANTATION, Vol. 12(9), 1997, page A190
 - D8: JOURNAL OF NEPHROLOGY 2002 ITALY, Vol. 15, No. 2, 2002, pages 97-103
 - D9: INTERNATIONAL JOURNAL OF HEMATOLOGY, Vol. 70, No. 1, pages 1-6
 - D10: EUROPEAN HEART JOURNAL, Vol. 22, No. Abstract Supplement, September 2001 (2001-09), page 154
 - D11: NEPHROLOGY DIALYSIS TRANSPLANTATION, Vol. 10(2), pages 74-79
 - D12: DATABASE BIOSIS [Online]; 2002, KASHIWAGI M ET AL.: "Hypertension in a pregnancy with renal anemia after recombinant human erythropoietin (rhEPO) therapy."
 - D13: DATABASE BIOSIS [Online]; 1997, CONRAD KIRK P ET AL.: "Placental cytokines and the pathogenesis of preeclampsia"
 - D14: WO 03/037273 A
 - D15: DATABASE EMBASE [Online]; 2000, CASES A: "Recombinant human erythropoietin treatment in chronic renal failure: Effects on hemostasis and vasculature"
 - D16: DATABASE MEDLINE [online]; 1996, BRAGA J ET AL.: "Maternal and perinatal implications of the use of human recombinant erythropoietin."
 - D17: WO 02/085940 A
 - D18: DATABASE BIOSIS [Online]; 2001, ARCASOY MURAT O ET AL.: "Erythropoietin (EPO) stimulates angiogenesis in vivo and promotes wound healing"
 - D19: WO 89/07944 A

D20: WO 92/15323 A
D21: US-A-4 992 419
D22: US-A-5 198 417
D23: DATABASE BIOSIS [Online]; 1998, ALVAREZ ARROYO MARIA VICTORIA ET AL.: "Role of vascular endothelial growth factor on erythropoietin-related endothelial cell proliferation"

- 3.1 Document D1 discloses the use of EPO for treating heart failure. Assuming that the priority is valid, document D1 is not included in the prior art for the international preliminary examination.
- 3.2 Document D2 describes the use of EPO for treating chronic heart failure where appropriate associated with renal failure with 5, 75, 150 and 200 IU/kg, once to three times per week (claims 35 and 36).
- 3.3 Document D3 discloses the use of EPO in combination with an iron compound for improving cardiac function. A dose of 500-10 000 IU/week is administered.
- 3.4 Document D4 discloses pharmaceutical compositions comprising EPO for protection against hypotension, ischemia, myocardial infarction and inflammation.
- 3.5 Document D5 describes the protection of endothelial cells from damage by certain doses of EPO, and the demonstration that EPO has a mitogenic and migratory effect on endothelial cells, which represents a key step in angiogenesis. Damage to be treated according to the invention includes that caused by inflammation, cardiac diseases and atherosclerosis. EPO is used for the treatment of anemia (associated with chronic renal failure).
- 3.6 Document D6 describes a method for the treatment of damaged blood vessels, where EPO is administered as endothelial cell mitogen, and endothelial progenitor cells are isolated and readministered. This method can also be used to treat a wide variety of ischemias (e.g. renal).
- 3.7 Document D7 describes the protective effect of EPO against atherosclerosis in hypercholesterolemic rabbits.
- 3.8 Document D8 describes the role of rEPO in chronic inflammatory diseases (neopterin reduction) and the stimulation of endothelial cells (angiogenesis) apart from the conventional treatment of anemia (in patients with chronic renal failure). There are references to the suitability of EPO for wound healing. The synergy of VEGF and EPO is described.
- 3.9 Document D9 discloses the angiogenic activity of EPO and the stimulation of proliferation and migration of endothelial cells.

- 3.10 Document D10 discloses the angiogenic potential of EPO.
- 3.11 Document D11 describes the association between EPO treatment and high blood pressure.
- 3.12 Document D12 discloses that EPO treatment increases the blood pressure in pregnant women.
- 3.13 Document D13 is a hypothesis linking preeclampsia with placental cytokines.
- 3.14 Document D14 discloses the use of EPO for treating acute ischemic renal failure using subpolycythemic doses. The treatment leads to cell repair (example 6). Assuming the priority is valid, document D14 is not included in the prior art for the international preliminary examination.
- 3.15 Documents D15 and D16 disclose the use of EPO for treating renal failure.
- 3.16 Document D17 discloses EPO derivatives for treating various diseases such as wound healing, renal failure, cardiovascular disorders and rejection reactions.
- 3.17 Document D18 discloses the pro-angiogenic effect of EPO and its promotion of wound healing.
- 3.18 Document D19 discloses neovascularization implants which may be coated with cells able to produce EPO.
- 3.19 Document D20 discloses a method for increasing the cell population by ex vivo stimulation with a morphogen. EPO is a corresponding factor of the hemopoietic system.
- 3.20 Document D21 discloses pharmaceutical compositions comprising EPO and L-arginine.
- 3.21 Document D22 discloses the coadministration of EPO and GM-CSF.
- 3.22 Document D23 discloses the synergistic interaction of EPO with VEGF.

4. Novelty:

- 4.1 Claims 1-14 relate to the use of erythropoietin for producing a pharmaceutical composition comprising a dose of from 500 to 2 000 units of EPO/week/patient for treating various diseases. Since none of the documents discloses the use of such doses for treating the stated diseases, the subject-matter of claims 1-14 and of the further dependent claims 29-32 and of claim 43 appears to be novel.
- 4.2 Claims 15-23 relate to the use of EPO for producing transplantable endothelial cell preparations, for producing cell-containing organ or tissue systems and for producing heart valves. Since none of documents D2-D23 discloses such

methods, the subject-matter of these claims appears to be novel.

- 4.3 Claims 24 and 38 relate to the use of erythropoietin in a dose of from 500 to 2 000 units of EPO/week/patient to stimulate endothelial cells and to stimulate vasculogenesis, respectively. However, since cardiac diseases and ischemias fall under this definition (e.g. D5 or D6, original claims), the subject-matter of this claim and of claims 25-28 and 38-42 appears not to be novel in relation to (at least) D2 and D3.
- 4.4 Claims 33 and 34 relate to a pharmaceutical composition comprising erythropoietin in a dose of from 500 to 2 000 units of EPO/week/patient respectively alone and in combination with further active ingredients. Claim 34 appears not to be novel in relation to D2 and D3. Since it is unclear whether the claims relate to single doses or not, the subject-matter of claims 33-37 appears not to be novel in relation to D21-23 either.

5. Inventive step:

- 5.1 Claims 1 and 2 relate to the use of erythropoietin for producing a pharmaceutical composition comprising a dose of from 500 to 2 000 units of EPO/week/patient for treating chronic and acute renal failure, respectively. Document D2 can be regarded as the closest prior art and discloses the use of EPO for treating renal anemias based on chronic renal failure.
- It was shown in the application that, on treatment of chronic or acute renal failure with the subpolycythemic doses according to the invention, a renal tissue regeneration takes place. Since the treatment is carried out in the prior art by compensating the EPO missing from the body with an increase in the hematocrit values, the use of subpolycythemic doses appears not to be obvious.
- 5.2 Claim 3 relates to the use of erythropoietin for producing a pharmaceutical composition comprising a dose of from 500 to 2 000 units of EPO/week/patient for wound healing. Document D18, which is regarded as the closest prior art, discloses the angiogenic function of EPO in wound healing and differs through the dose used.
- The problem to be solved is the provision of an improved treatment of wounds. Since such an effect was shown, the subject-matter of claim 3 appears to be

inventive.

- 5.3 Claim 4 relates to the use of erythropoietin for producing a pharmaceutical composition comprising a dose of from 500 to 2 000 units of EPO/week/patient for treating various diseases.

Starting from documents D5-D7 and D11-D13, which disclose the treatment of these diseases with EPO, the problem to be solved is the provision of an improved treatment. Since there is no evidence of an improvement, the subject-matter of claims 4-14, 29-32 and 43 appears not to be inventive.

- 5.4 The subject-matter of claims 15-23, which is not supported by any data in the application, appears to be an arbitrary application of the properties of EPO which are disclosed in documents D5, D6, D8-D10 and D19-D20 and thus appears not to be inventive.

It is particularly preferred according to the invention for erythropoietin, in all the uses, methods and compositions of the present disclosure, to be used in very small amounts which are below the amounts known to be employed, administering in particular in vivo, i.e. per patient, EPO doses of from 200 to 2 000 units (IU; international units)/week, preferably doses of from 500 to 2 000 IU/week, depending on the severity of the disorder and depending on renal function. The doses, provided according to the invention, of from 200 to 2 000 units (IU)/week and per patient, especially from 500 to 2 000 IU/week and per patient, are subpolycythemic doses, that is doses which do not lead to erythrocytosis with hematocrit values of more than 50%. The subpolycythemic doses provided according to the invention correspond to weekly doses of about 1 to 90 units (IU) of EPO/kg of body weight, in particular 1 to 45 IU of EPO/kg of body weight, or a comparable weekly dose of Aranesp of from 0.005 to 0.45 µg/kg of body weight, in particular 0.005 to 0.225 µg/kg of body weight. Aranesp is a doubly PEGylated EPO. The dose of from 200 to 2 000 units/week per patient, in particular from 500 to 2 000 IU/week and per patient, which is provided according to the invention for the treatment of diseases or pathological states associated with a dysfunction of endothelial progenitor cells is very low compared with the initial dose of 50-150 IU/kg of body weight/week (usually starting with 4 000-8 000 IU/week, but also considerably

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higher if the result of therapy is unsatisfactory) normally employed for the therapy of renal anemia.

A particularly preferred embodiment of the invention relates to the use of erythropoietin and/or its derivative as active ingredient for producing a pharmaceutical composition or a medicament for the therapy of pathological states or diseases associated with a dysfunction of endothelial progenitor cells.

An "active ingredient" means according to the invention an endogenous or exogenous substance which on contact with target molecules or target cells or target tissues influences in a differentiated manner specific functions of tissues, organs or organisms. The invention thus provides for erythropoietin as active ingredient of the pharmaceutical composition of the invention influencing the proliferation, differentiation and/or migration behavior of endothelial progenitor cells on contact therewith in a human or animal organism in such a way that dysfunctions of endothelial progenitor cells can be compensated and the diseases occurring as a consequence of these dysfunctions effectively controlled, alleviated or eliminated, or these diseases effectively prevented.

In connection with the present invention, a "pharmaceutical composition" or a "medicament" means a mixture which is used for diagnostic, therapeutic and/or prophylactic purposes, that is promoting or restoring the health of a human

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Claims

1. The use of erythropoietin for producing a pharmaceutical composition comprising a dose of from 500 to 2 000 units of EPO/week/patient for the treatment of chronic renal failure.
2. The use of erythropoietin for producing a pharmaceutical composition comprising a dose of from 500 to 2 000 units of EPO/week/patient for the treatment of acute renal failure.
3. The use of erythropoietin for producing a pharmaceutical composition comprising a dose of from 500 to 2 000 units of EPO/week/patient for wound healing.
4. The use of erythropoietin for producing a pharmaceutical composition comprising a dose of from 500 to 2 000 units of EPO/week/patient for the therapy of hypercholesterolemia, diabetes mellitus, endothelium-mediated chronic inflammatory disorders, endotheliosis including reticuloendotheliosis, atherosclerosis, ischemic disorders of the extremities, preeclampsia, Raynaud's disease or pregnancy-induced hypertension.
5. The use as claimed in any of claims 1 to 4, where the pharmaceutical composition is suitable for parenteral, in particular intravenous, intramuscular, intracutaneous or subcutaneous, administration.
6. The use as claimed in claim 5, where the pharmaceutical composition is in the form of an injection or

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infusion.

7. The use as claimed in any of claims 1 to 4, where the pharmaceutical composition is suitable for pulmonary administration.

8. The use as claimed in claim 7, where the pharmaceutical composition is in the form of an aqueous solution, nonaqueous solution or powder.

9. The use as claimed in claim 7 or 8, where the pharmaceutical composition is in the form of an aerosol product.

10. The use as claimed in any of claims 1 to 4, where the pharmaceutical composition is suitable for oral administration.

11. The use as claimed in claim 10, where the pharmaceutical composition is in the form of a solution, suspension, emulsion or tablet.

12. The use as claimed in any of claims 1 to 11, where the pharmaceutical composition comprises at least one further active ingredient to stimulate endothelial progenitor cells.

13. The use as claimed in claim 12, where the further active ingredient is VEGF, PIGF, GM-CSF, an HMG-CoA reductase inhibitor and/or an NO donor, especially L-arginine.

14. The use as claimed in claim 13, where the HMG-CoA reductase inhibitor is a statin such as simvastatin, mevastatin or atorvastatin.

15. The use of erythropoietin for producing a transplantable endothelial cell preparation.

16. The use as claimed in claim 15, where endothelial cells are produced in vitro by cultivating endothelial progenitor cells in the presence of erythropoietin.

17. The use as claimed in claim 15 or 16, where the cultivation of the endothelial progenitor cells takes place in the presence of at least one further active ingredient selected from the group consisting of VEGF, PIGF, GM-CSF, an HMG-CoA reductase inhibitor, especially simvastatin, mevastatin or atorvastatin, and an NO donor, especially L-arginine.

18. The use of erythropoietin for the pretreatment and/or further treatment of tissue or organ transplants.

19. The use as claimed in claim 18, where the pretreatment of the tissue or organ transplants takes place with use of isolated endothelial progenitor cells.

20. The use of erythropoietin for producing implantable or transplantable cell-containing in vitro organ or tissue systems, where the in vitro organ or tissue systems are treated with erythropoietin before the transplantation or implantation to induce vasculogenesis and/or endothelial cell formation.

21. The use as claimed in claim 20, where the in vitro organ or tissue systems comprise endothelial progenitor cells.

22. The use of erythropoietin to produce vascular prostheses or heart valves, where the vascular prostheses or heart valves are coated with erythropoietin.

23. The use as claimed in claim 22, where the coating of the vascular prostheses or heart valves comprises endothelial progenitor cells.

24. The use of erythropoietin and/or derivatives thereof in a dose of from 500 to 2 000 units of EPO/week/patient to stimulate physiological mobilization of endothelial progenitor cells, proliferation of endothelial progenitor cells, differentiation of endothelial progenitor cells to endothelial cells and/or migration of endothelial progenitor cells in the direction of an angiogenic or vasculogenic stimulus.

25. The use as claimed in claim 24, where the adhesion ability of differentiating endothelial progenitor cells is increased.

26. The use as claimed in claim 24 or 25, where the stimulation of endothelial progenitor cells leads to the formation of endothelial tissue.

27. The use as claimed in any of claims 24 to 26, where the stimulation of endothelial progenitor cells leads to the formation of new blood vessels.

28. The use of erythropoietin for producing a pharmaceutical composition comprising a dose of from 500 to 2 000 units of EPO/week/patient to stimulate the formation of

endothelial tissue.

29. The use as claimed in any of claims 1 to 28, where erythropoietin is human or animal erythropoietin.

30. The use as claimed in claim 29, where erythropoietin is a derivative, an analog, a modification or a mutein of erythropoietin.

31. The use as claimed in claim 29 or 30, where erythropoietin is isolated from human urine, the urine or plasma of patients suffering from aplastic anemia, tissue cultures of human renal cancer cells, human lymphoblast cells having the ability to produce human erythropoietin, or a hybridoma culture obtained by cell fusion of a human cell line.

32. The use as claimed in claim 29 or 30, where erythropoietin is an erythropoietin produced by DNA recombination techniques.

33. A pharmaceutical composition to stimulate endothelial progenitor cells, to stimulate the formation of endothelial tissue, to stimulate vasculogenesis and/or for the treatment of diseases or pathological states associated with a dysfunction of endothelial progenitor cells, comprising erythropoietin and/or a derivative, an analog, a modification or a mutein thereof as active ingredient in a dose of from 500 to 2000 units of EPO/week/patient, and at least one further active ingredient selected from the group consisting of VEGF, PIGF, GM-CSF, an HMG-CoA reductase inhibitor and an NO donor.

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34. A pharmaceutical composition for the prophylaxis and/or therapy of hypercholesterolemia, diabetes mellitus, endothelium-mediated chronic inflammatory disorders, endotheliosis including reticuloendotheliosis, atherosclerosis, ischemic disorders of the extremities, preeclampsia, Raynaud's disease, pregnancy-induced hypertension, chronic or acute renal failure, especially terminal renal failure, wound healing and sequelae thereof, comprising erythropoietin and/or a derivative, an analog, a modification or a mutein thereof as active ingredient in a dose of from 500 to 2 000 units/week/patient.

35. The pharmaceutical composition as claimed in claim 34, additionally comprising a further active ingredient selected from the group consisting of VEGF, PlGF, GM-CSF, an HMG-CoA reductase inhibitor and an NO donor.

36. The pharmaceutical composition as claimed in claim 33 or 35, where the HMG-CoA reductase inhibitor is a statin such as simvastatin, mevastatin or atorvastatin.

37. The pharmaceutical composition as claimed in claim 33 or 35, where the NO donor is L-arginine.

38. The use of erythropoietin and/or derivatives thereof in a dose of from 500 to 2 000 units of EPO/week/patient for stimulating vasculogenesis.

39. The use of erythropoietin in a dose of from 500 to 2 000 units of EPO/week/patient for the therapy of pathological states or diseases of the human or animal body

associated with a dysfunction of endothelial progenitor cells.

40. The use as claimed in claim 39, where the dysfunction of endothelial progenitor cells consists of their impaired ability to proliferate, their impaired ability to differentiate to endothelial cells, their impaired ability to adhere and/or their impaired ability to migrate in the direction of a vasculogenic or angiogenic stimulus.

41. The use as claimed in claim 39 or 40, where the dysfunction of endothelial progenitor cells impairs or prevents the formation of endothelial tissue and/or blood vessels.

42. The use as claimed in any of claims 39 to 41, where the dysfunction of endothelial progenitor cells has a pathogenic cause.

43. The use as claimed in any of claims 39 to 42, where the pathological states or diseases associated with a dysfunction of endothelial progenitor cells are hypercholesterolemia, diabetes mellitus, endothelium-mediated chronic inflammatory disorders, endotheliosis including reticuloendotheliosis, atherosclerosis, ischemic disorders of the extremities, preeclampsia, Raynaud's disease, pregnancy-induced hypertension, chronic or acute renal failure, especially terminal renal failure, wound healing and sequelae thereof.